OFFICE OF FINANCIAL RESEARCH

Intermediation Networks and Derivative Market Liquidity: Evidence from CDS Markets

Mark Paddrik[†]
Stathis Tompaidis[‡]

2023 Financial Stability Conference
Financial Stability in Times of Macroeconomic Uncertainty
November 17, 2023, Federal Reserve Bank of Cleveland

[†]Office of Financial Research
[‡]McCombs School of Business, University of Texas at Austin

Motivation

- Study the relationship between intermediation networks and market liquidity in over-the-counter markets
- Over-the-counter (OTC) derivative markets rely on dealers to intermediate trade and provide market liquidity through both holding and managing inventories.
- To maintain these services, dealers form intermediation trade networks with clients and other dealers to offset risk.
- These networks, which are influenced by regulations, affect market liquidity; i.e., the ease of trade.
- Trades and prices reflect the best option for both dealers and clients, and also the existence of indirect options; i.e., the options of a dealer, as well as the options of a dealer's counterparties, to rebalance positions

This Paper

- Studies both the dealer-to-client network and the inter-dealer network
- Considers both networks at the individual dealer level and the aggregate, market, level
- Provides a theoretical model that connects intermediation networks and market liquidity based on cooperatively splitting surplus from trade between dealers
- Uses supervisory data on the U.S single name CDS market to measure the intermediation network in terms of network completeness
- Determines the relationship between measures of the intermediation network and measures of liquidity:
  - Trade Volume
  - Dealer Inventories
  - Trade Costs

Our Results

1. A market's **volume** *increases* as an intermediation network is more complete, both in the case of the **dealer-to-client** and **interdealer** subnetworks.

2. A **dealer's inventory** *increases* with higher dealer-level intermediation network completeness, while at the market-level higher network completeness *reduces* a **dealer's inventory**.

3. At the dealer-level, **trading costs** *decline* as network completeness *increases*. Our results sharpen prior predictions by finding that dealer **trade costs** are primarily linked to **interdealer** relationships.

4. At the market-level, *higher* level of completeness are linked to *lower* **trading costs**. This reduction is associated with the completeness of the **interdealer** network.
    - accounting for the interdealer network *reduces* the importance of the networks of individual dealers.

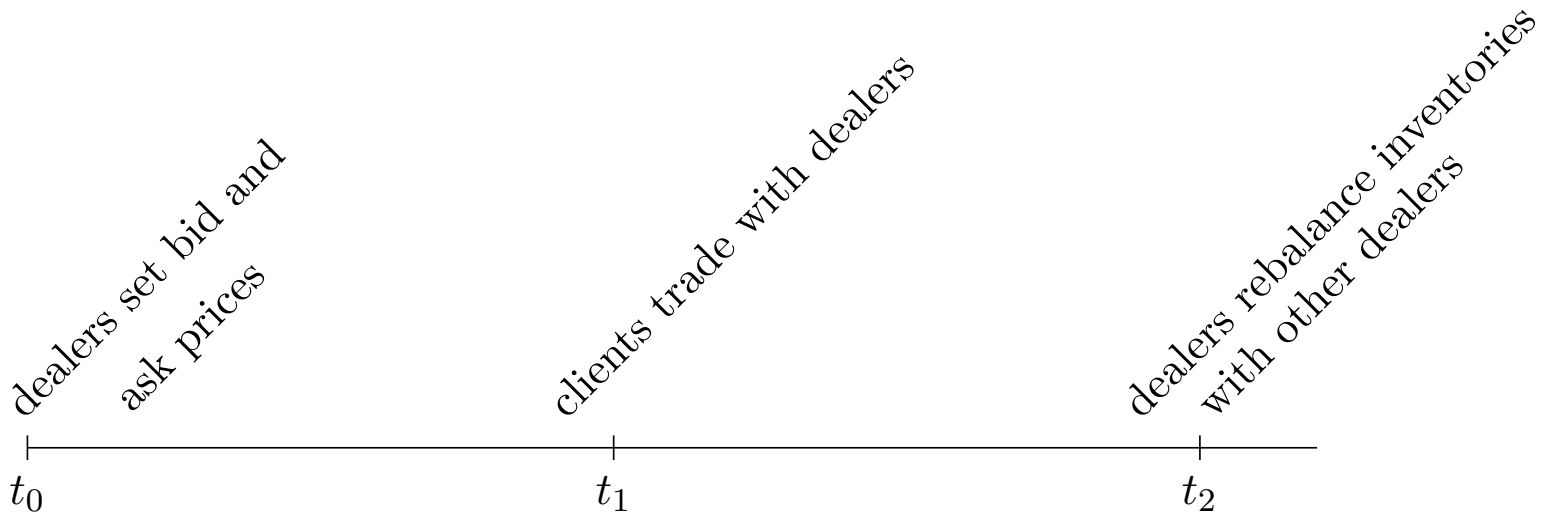
Literature

- Dealer inventory management and risk (theory)
  - Ho and Stoll (1983); Viswanathan and Wang (2004); Duffie et al. (2005)
- Intermediation networks and market liquidity (theory)
  - Gofman (2011); Babus and Kondor (2018); Neklyudov (2019); Yang and Zeng (2019); Wang (2018)
- Dealer-level intermediation networks (empirical)
  - Di Maggio et al. (2017); Hollifield et al. (2017); Li and Schürhoff (2019)
- CDS markets
  - Oehmke and Zawadowski (2015); Shachar (2012); Siriwardane (2019); Du et al. (2019); Collin-Dufresne et al. (2020); D'Errico et al. (2018); Eisfeldt et al. (2023)

MODEL

Model setup

- Key assumptions:
  - each dealer is a monopolist to her clients
  - **costs** are due to:
    - A dealers holding costs that increase with inventory
    - B the length of the intermediation chain
  - the ability to reduce A and B generates a **surplus**
  - dealers form coalitions → to generate a surplus they split



Model: t_2 dealer intermediation and surplus sharing

- Dealers trade with one another to offset inventory costs from trading with clients and share the **trade surplus**.
- Dealers divide the trade surplus based on **Shapley values** (Shapley (1951)).
  - Shapley values divide surplus based on each dealer's marginal contribution to the generation of surplus
  - a concept from cooperative game theory to distribute gains across actors working in coalition
  - cooperation stems from the repeated interaction of dealers
  - Shapley values, and share of trade surplus, for a dealer increase as her connections to other dealers increase, because the dealer participates in more coalitions

Model: t_1 client transactions

- Each dealer is connected to a subset of $\mathcal{C}$ clients that can only transact with her.
- Downward sloping demand curve: given the ask price (bid price), the probability that clients are buyers (sellers) declines as prices increase (decrease)

Model: t_0 dealers set bid and ask prices

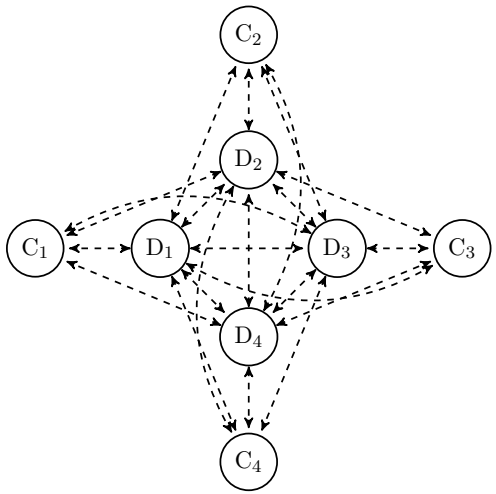
Proposition

- *A decrease in a dealer's marginal cost to rebalance her inventory* $\Rightarrow$ *lower ask and higher bid prices*
- *An increase in a dealer's marginal cost to rebalance her inventory* $\Rightarrow$ *higher ask and lower bid prices*

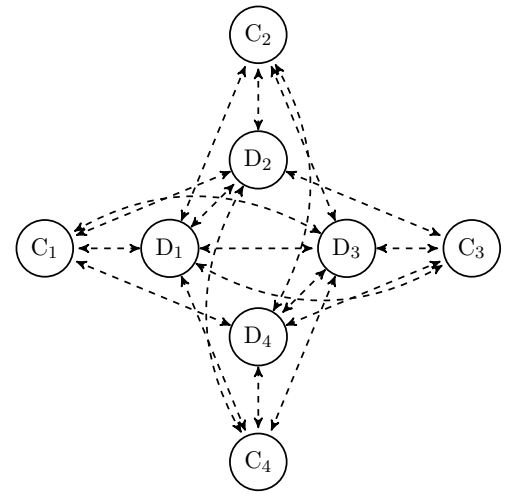
- By acquiring an additional connection, a dealer captures a bigger share of trade surplus when trading with other dealers, thereby reducing her marginal cost of taking on and rebalancing a new position.

Intermediation Network Completeness

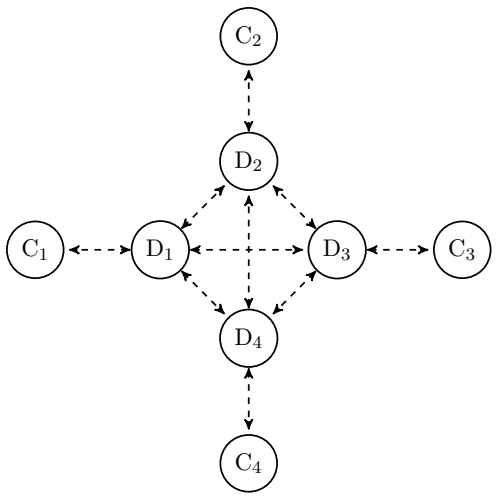
Shapley values and network completeness: dealer vs. market



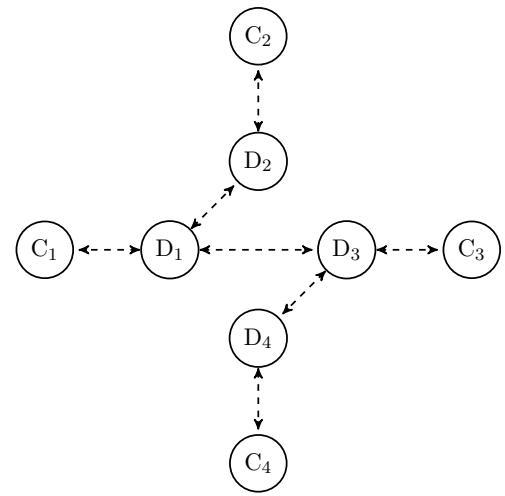
(a) Complete



(b) Complete Dealer-to-Client



(c) Complete Interdealer



(d) Sparse

Measuring Completeness

- The number of relationships for participant i are given by

$$k_i = \sum_{i \neq j} a_{ij}, \quad i, j \in \mathcal{M}$$

where a_{ij} is equal to 1 if parties i and j are connected and the sum is over all market participants in a particular CDS market, $\mathcal{M}$.

Dealer Completeness:

$$\mathrm{k}_i^{\mathrm{D}} = \frac{\sum_{j \neq i} a_{ij}}{|\mathcal{D}| - 1}, \quad i, j \in \mathcal{D}; \qquad \mathrm{k}_i^{\mathrm{C}} = \frac{\sum a_{ij}}{|\mathcal{C}|}, \quad i \in \mathcal{D}, j \in \mathcal{C}.$$

(a) Interdealer (b) Dealer-to-Client

Market Completeness:

$$\mathrm{K}^{\mathrm{D}} = \frac{\sum_i \sum_{j>i} a_{ij}}{|\mathcal{D}|(|\mathcal{D}| - 1)/2}, \quad i, j \in \mathcal{D}; \qquad \mathrm{K}^{\mathrm{C}} = \frac{\sum_i \sum_j a_{ij}}{|\mathcal{D}||\mathcal{C}|}, \quad i \in \mathcal{D}, j \in \mathcal{C}.$$

(a) Interdealer (b) Dealer-to-Client

DATA AND SUMMARY STATISTICS

Data

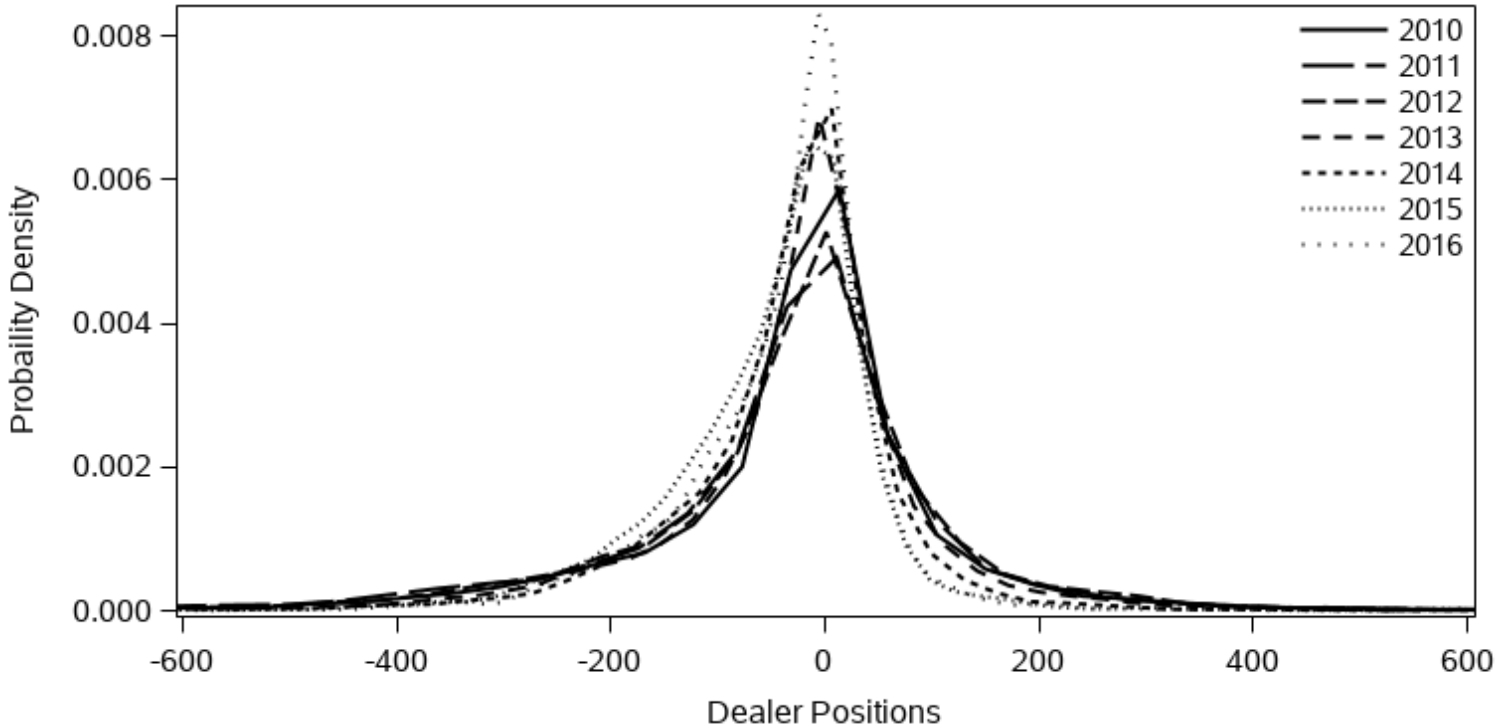
- DTCC CDS data repository covering all counterparties and/or reference entities with U.S.-domicile.
- We use all **single-name corporate U.S. reference entities'** weekly transactions and positions.
  - 1032 reference IDs on senior tier debt
  - counterparty firms identified
  - all maturities, coupons, etc.
  - priced using underlying transaction information and Markit average
- Regulatory TRACE: Transactions on corporate bonds
  - CUSIP matched to underlying single-name
- Markit CDS Daily Pricing
- Period: 1/2010 thru 11/2016

CDS Statistics: volume, inventories, & participants

	2010	2011	2012	2013	2014	2015	2016
Volume ($M)	2,350.6	935.5	639.0	463.2	372.1	192.6	134.9
	(1886.9)	(5878.0)	(1380.9)	(927.9)	(701.4)	(316.3)	(305.9)
Interdealer Volume ($M)	2,262.3	770.5	530.6	373.4	282.9	127.4	72.1
	(1885.4)	(1761.5)	(1267.2)	(826.5)	(605.6)	(264.3)	(270.6)
Client Volume ($M)	88.2	165.0	108.4	89.8	89.2	65.2	62.8
	(18.8)	(5585.8)	(227.3)	(179.2)	(174.6)	(108.8)	(103.6)
Dealer Net Notional ($M)	-17.5	-32.5	-20.8	-20.4	-24.9	-42.7	-35.4
	(20.5)	(263.7)	(243.6)	(195.2)	(180.0)	(133.7)	(101.1)
Dealer Gross Notional ($M)	7,151.0	7,510.8	7,003.4	5,210.8	3,649.6	2,716.0	1,962.4
	(974.6)	(9407.0)	(9369.0)	(7181.4)	(5267.3)	(3847.9)	(2946.4)
# of Dealers	10.1	10.1	9.1	8.1	7.2	6.4	5.2
	(0.9)	(4.8)	(4.1)	(3.8)	(3.4)	(2.9)	(2.7)
# of Clients	4.3	5.2	5.3	4.5	4.3	4.1	4.4
	(0.6)	(6.5)	(6.8)	(6.3)	(5.9)	(5.2)	(4.9)

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

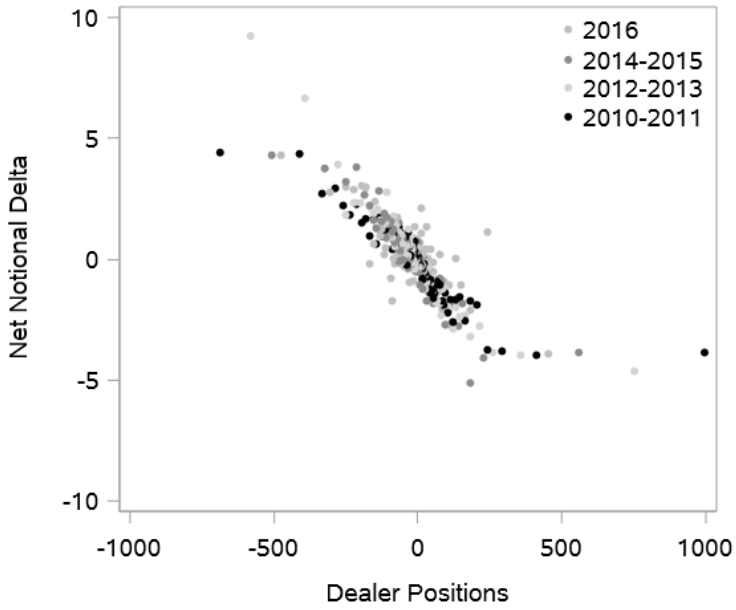
CDS Statistics: dealer inventory



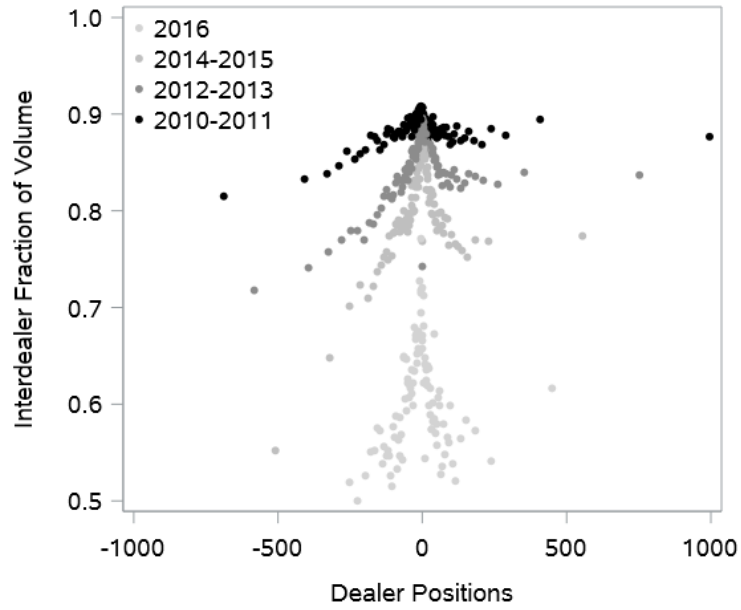
Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

- The plot presents the probability density of weekly dealer positions ($ millions) across our sample of U.S. single-name CDS markets.
- The overlay highlights the tightening of inventory by dealers over time.

CDS Statistics: dealer inventory management



(a) Weekly Inventory Change given Previous Week's Inventory

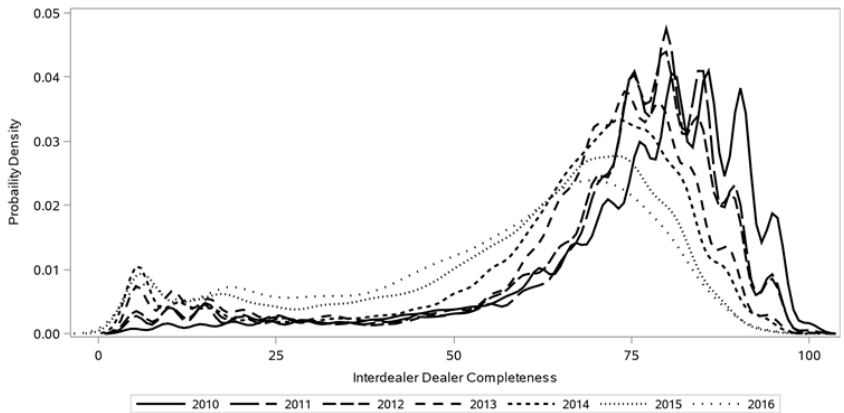


(b) Interdealer Fraction of Trade given Previous Week's Inventory

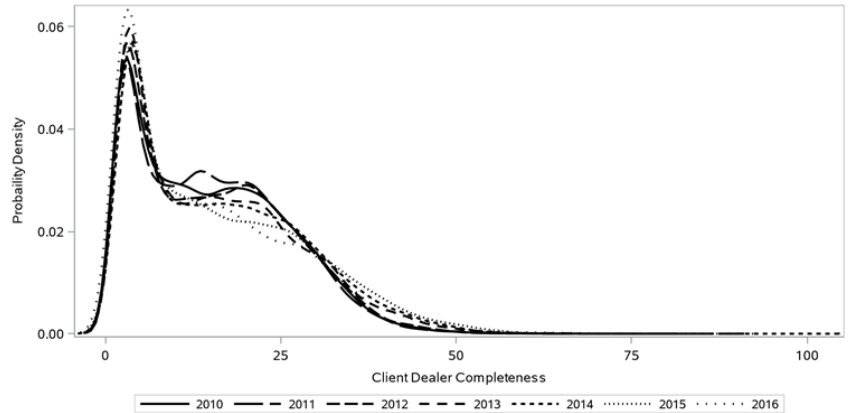
Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

- Plot (a): as inventories grow away from zero, dealers work to reduce their inventory risk.
- Plot (b): a tightening of inventory by dealers over time, and a growing tendency of dealers to offset inventories with clients.

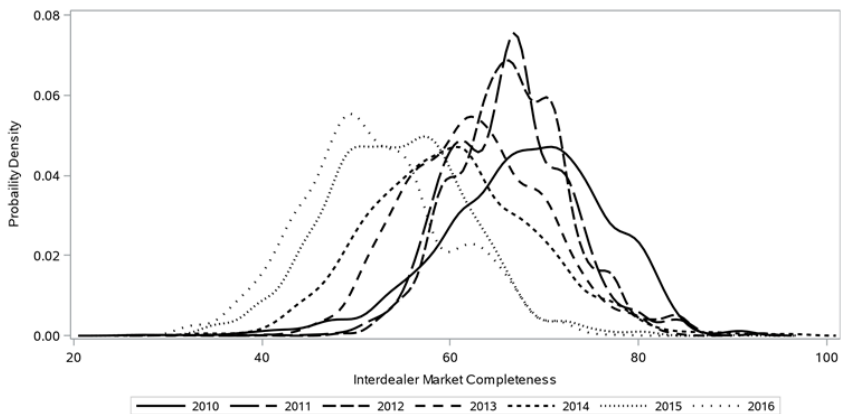
CDS Statistics: intermediation networks



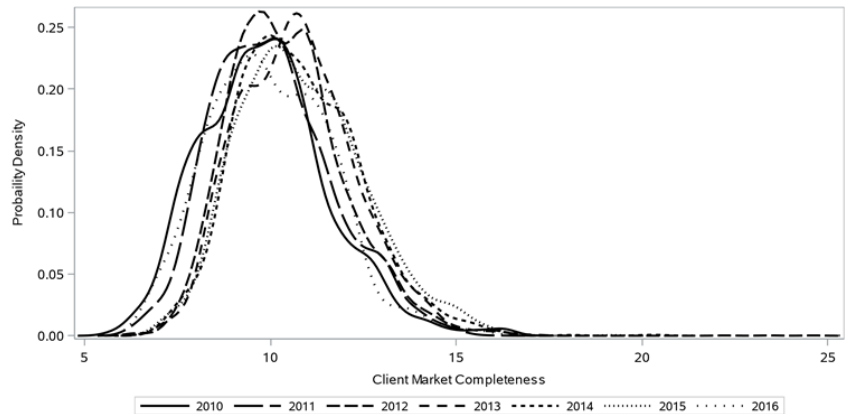
(a) Interdealer Dealer Completeness



(b) Dealer-to-Client Dealer Completeness



(c) Interdealer Market Completeness



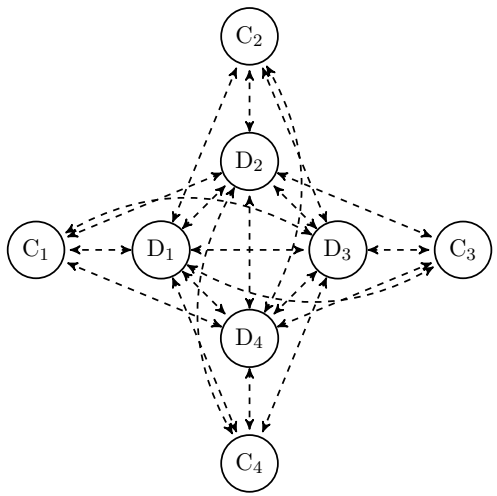
(d) Dealer-to-Client Market Completeness

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

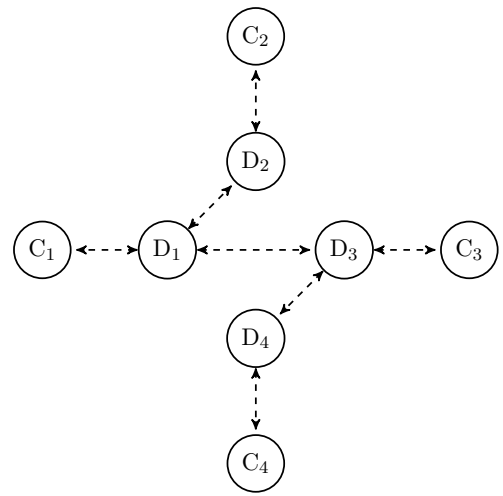
MODEL HYPOTHESES
&
EMPIRICAL RESULTS

Hypothesis H1: client volume

H1: *The completeness of a* ***market's intermediation network*** *is positively related to the transaction* ***volume between dealers and clients***.



(a) High K^D, High K^C



(b) Low K^D, Low K^C

- Controls for demand, fixed effects

Hypothesis H1: client volume

	Dependent Variable			
	log(Client Volume)			
	(1)	(2)	(3)	(4)
Intercept	4.1000***	3.5409***	3.7766***	3.4533***
Interdealer Market Completeness		**0.0082*** **		**0.0061*** **
Dealer-to-Client Market Completeness			**0.0379*** **	**0.0267*** **
CDS spread	1.3409***	1.2907***	1.1012***	1.1341***
ΔCDS spread	-0.2721	-0.2476	-0.1929	-0.1978
CDS Recovery Rate	0.7434***	0.5875***	0.6129***	0.5346***
log(Bond Volume)	0.1139***	0.1218***	0.1080***	0.1157***
log(Client Index CDS Volume)	0.2481***	0.2495***	0.2503***	0.2506***
CDS Clearing Eligible	-0.0005	0.0163	0.0395***	0.0402***
Interdealer Volume Share	-0.0096***	-0.0097***	-0.0097***	-0.0097***
Time Fixed Effects	Y	Y	Y	Y
Observations	36,248	36,248	36,248	36,248
Adjusted R^2	27.09%	28.29%	28.18%	28.76%

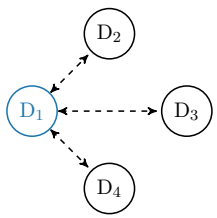
Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

- Client volume and intermediation network completeness are *positively* related, in both the dealer-to-client and interdealer segments.

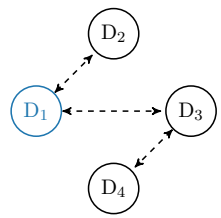
Hypothesis H2 & H3 (a): individual dealer inventory

H2: *The completeness of a **dealer's intermediation network** is positively related to the **dealer's risk-bearing capacity**, i.e. the dealer's net inventory.*

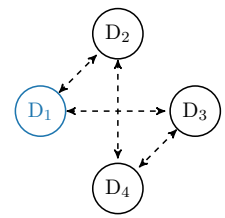
H3 (a): *The completeness of a **market's intermediation network**, controlling for the completeness of the intermediation network of individual dealers, is positively related to the **risk-bearing capacity of individual dealers**, i.e., their net inventory.*



(a) High k_1^D, Low K^D



(b) Low k_1^D, Low K^D



(c) Low k_1^D, High K^D

- Controls for demand, fixed effects

Hypothesis H2 & H3 (a): individual dealer inventory

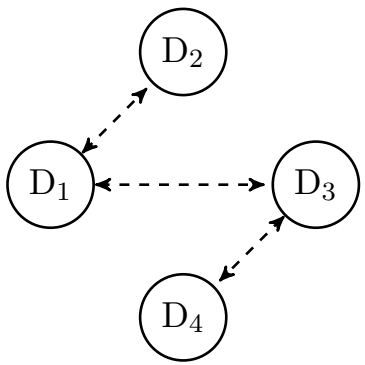
	Dependent Variable			
	log(Dealer ‖Inventory‖)			
	(1)	(2)	(3)	(4)
Intercept	7.5027***	6.4385***	7.3278***	6.7409***
Interdealer Dealer Completeness		**0.0124*** **		**0.0129*** **
Dealer-to-Client Dealer Completeness		**0.0051*** **		**0.0047*** **
Interdealer Market Completeness			**0.0027*** **	**-0.0052*** **
Dealer-to-Client Market Completeness			0.0006	-0.0014
CDS Clearing Eligible	0.0116***	0.0251***	0.0115***	0.0263***
log(Client Volume)	0.0015	0.0032	0.0009	0.0045**
Interdealer Volume Share	0.0000	0.0000	0.0000	0.0000
Time Fixed Effects	Y	Y	Y	Y
Reference Entity Fixed Effects	Y	Y	Y	Y
Observations	470,264	470,264	470,264	470,264
Adjusted R^2	9.14%	22.13%	9.19%	22.31%

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

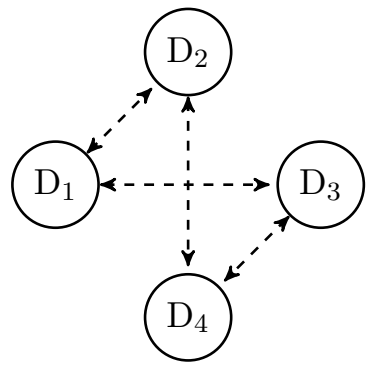
- Intermediation network completeness, both dealer-to-client and interdealer, *positively* related to dealer inventory.
- However, market interdealer intermediation network completeness *negatively* related to dealer inventory.

Hypothesis H3 (b): aggregate dealer inventory

H3 (b): *The completeness of a **market's intermediation network**, controlling for the completeness of the intermediation network of individual dealers, is positively related to the **gross risk-bearing capacity of all dealers**.*



(a) Low K^D



(b) High K^D

- Controls for demand, fixed effects

Hypothesis H3 (b): aggregate dealer inventory

	Dependent Variable			
	log(Σ Individual Dealer ‖Inventory‖)			
	(1)	(2)	(3)	(4)
Intercept	8.5227***	8.2679***	8.3913***	8.2076***
Interdealer Market Completeness		**0.0042*** **		**0.0035*** **
Dealer-to-Client Market Completeness			**0.0172*** **	**0.0106*** **
CDS Clearing Eligible	0.0904***	0.0916***	0.0921***	0.0924***
log(Client Volume)	0.0158***	0.0146***	0.0149***	0.0143***
Interdealer Volume Share	0.0002***	0.0002***	0.0002***	0.0002***
Time Fixed Effects	Y	Y	Y	Y
Reference Entity Fixed Effects	Y	Y	Y	Y
Observations	36,508	36,508	36,508	36,508
Adjusted R^2	81.54%	82.05%	81.86%	82.15%

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

- Intermediation network completeness, both dealer-to-client and interdealer, *positively* related to aggregate dealer inventories.

Hypothesis H4 & H5: trade costs

H4: *The completeness of a **dealer's intermediation network** is negatively related to the **bid-ask spread** faced by clients and individual dealers.*

H5: *The completeness of a **market's intermediation network**, conditional on the completeness of the intermediation network of individual dealers, is negatively related to the **bid-ask spreads** faced by clients and individual dealers.*

$$\text{Bid-Ask Spread: } \gamma_{i,j,t} = \left| \frac{\text{CDS Transaction Spread}_{i,j,t} - \text{CDS Markit Spread}_{j,t}}{\text{CDS Markit Spread}_{j,t}} \right| \quad (1)$$

- Controls for participation, inventory, demand, fixed effects

Hypothesis H4 & H5: dealer-to-client bid-ask spread

	Dependent Variable			
	Dealer-to-Client Bid-Ask Spread			
	(1)	(2)	(3)	(4)
Intercept	8.1679	12.5522**	12.6502*	14.4924**
Interdealer Dealer Completeness		**-0.0551*** **		**-0.0468*** **
Dealer-to-Client Dealer Completeness		0.0000		-0.0008
Interdealer Market Completeness			**-0.0695*** **	**-0.0381**
Dealer-to-Client Market Completeness			-0.0199	-0.0227
log(Dealer ‖Inventory‖)	-0.5635***	-0.4793***	-0.5743***	-0.4963***
log(‖Net All Dealer Inventory‖)	-0.3215*	-0.3028*	-0.3195*	-0.3036*
log(All Dealer ‖Inventory‖)	1.2448*	1.5369***	2.0847***	2.1290***
CDS Clearing Eligible	-0.1347	-0.1967	-0.1893	-0.2171
Number of Market Dealers	0.0264	-0.1215	-0.3314***	-0.3014**
Interdealer Volume Share	-0.0049	-0.0044	-0.0044	-0.0042
Time Fixed Effects	Y	Y	Y	Y
Reference Entity Fixed Effects	Y	Y	Y	Y
Observations	284,008	284,008	284,008	284,008
Adjusted R^2	5.00%	5.06%	5.03%	5.07%

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

- A dealer's bid-ask spread with clients is *negatively* related with the completeness of a dealer's network with other dealers.
- A dealer's bid-ask spread with clients is *negatively* related with the completeness of the interdealer network.

Hypothesis H4 & H5: interdealer bid-ask spread

	Dependent Variable			
	Interdealer Bid-Ask Spread			
	(1)	(2)	(3)	(4)
Intercept	15.0386***	16.1376***	21.1550***	21.2713***
Interdealer Dealer Completeness		-0.0135		-0.0029
Dealer-to-Client Dealer Completeness		-0.0025		-0.0037
Interdealer Market Completeness			**-0.0694*** **	**-0.0673*** **
Dealer-to-Client Market Completeness			**-0.0941** **	**-0.0884** *
log(Dealer ‖Inventory‖)	-0.0424	-0.0037	-0.0496	-0.0339
log(‖Net All Dealer Inventory‖)	-0.2575**	-0.2565**	-0.2442**	-0.2449**
log(All Dealer ‖Inventory‖)	0.3847	0.4419	1.2815***	1.2574***
CDS Clearing Eligible	1.0337***	1.0180***	0.9396***	0.9445***
Number of Market Dealers	-0.1540***	-0.1903***	-0.5636***	-0.5582***
Interdealer Volume Share	0.0064***	0.0068***	0.0071***	0.0071***
Time Fixed Effects	Y	Y	Y	Y
Reference Entity Fixed Effects	Y	Y	Y	Y
Observations	1,011,154	1,011,154	1,011,154	1,011,154
Adjusted R^2	9.37%	9.38%	9.44%	9.44%

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

- Dealer-to-dealer bid-ask spread is *not* related to the intermediation network the dealer maintains.
- Dealer-to-dealer bid-ask spread is *negatively* related with dealer-to-client and interdealer market-level completeness.

Conclusions

- We study the relationship between measures of intermediation networks and liquidity, and are able to identify how variation in OTC market subnetworks, and the entire network, relate to market liquidity.
- As intermediation networks can be influenced by regulatory changes, evaluating how relationships may evolve can provide a mechanism for estimating a regulation's impact on market liquidity.

References I

Babus, A. and Kondor, P. (2018). Trading and information diffusion in over-the-counter markets. *Econometrica*, 86(5):1727–1769.

Collin-Dufresne, P., Junge, B., and Trolle, A. B. (2020). Market structure and transaction costs of index CDSs. *The Journal of Finance*, 75(5):2719–2763.

Di Maggio, M., Kermani, A., and Song, Z. (2017). The value of trading relations in turbulent times. *Journal of Financial Economics*, 124(2):266–284.

Du, W., Gadgil, S., Gordy, M. B., and Vega, C. (2019). Counterparty risk and counterparty choice in the credit default swap market. Finance and Economics Discussion Series 2016-087, Board of Governors of the Federal Reserve System.

Duffie, D., Gârleanu, N., and Pedersen, L. H. (2005). Over-the-counter markets. *Econometrica*, 73(6):1815–1847.

D'Errico, M., Battiston, S., Peltonen, T., and Scheicher, M. (2018). How does risk flow in the credit default swap market? *Journal of Financial Stability*, 35:53–74.

Eisfeldt, A. L., Herskovic, B., Rajan, S., and Siriwardane, E. (2023). OTC intermediaries. *The Review of Financial Studies*, 36(2):615–677.

Gofman, M. (2011). A network-based analysis of over-the-counter markets. In *AFA 2012 Chicago Meetings Paper*.

References II

Ho, T. S. Y. and Stoll, H. R. (1983). The dynamics of dealer markets under competition. *The Journal of Finance*, 38:1053–1074.

Hollifield, B., Neklyudov, A., and Spatt, C. (2017). Bid-ask spreads, trading networks, and the pricing of securitizations. *The Review of Financial Studies*, 30(9):3048–3085.

Li, D. and Schürhoff, N. (2019). Dealer networks. *The Journal of Finance*, 74(1):91–144.

Neklyudov, A. (2019). Bid-ask spreads and the over-the-counter interdealer markets: Core and peripheral dealers. *Review of Economic Dynamics*, 33:57–84.

Oehmke, M. and Zawadowski, A. (2015). Synthetic or real? the equilibrium effects of credit default swaps on bond markets. *The Review of Financial Studies*, 28(12):3303–3337.

Shachar, O. (2012). Exposing the exposed: Intermediation capacity in the credit default swap market. Working Paper.

Shapley, L. S. (1951). *Notes on the N-person Game — II: The Value of an N-Person Game*. Rand Corporation, Santa Monica, CA.

References III

Siriwardane, E. N. (2019). Limited investment capital and credit spreads. *The Journal of Finance*, 74(5):2303–2347.

Viswanathan, S. and Wang, J. J. (2004). Inter-dealer trading in financial markets. *The Journal of Business*, 77(4):987–1040.

Wang, C. (2018). Core-periphery trading networks. Wharton Working Paper.

Yang, M. and Zeng, Y. (2019). The coordination of intermediation. University of Washington Working Paper.

APPENDIX

Hypothesis HA1: interdealer volume

- Hypothesis H2 is based on Wang (2018) which identifies a negative relation between the share of interdealer volume ($\lambda^{\mathrm{D}}/\lambda$) and the volume of transactions between dealers and clients (λ^{C}) in equilibrium.

$$\begin{aligned}\frac{\lambda^{\mathrm{D}}_{j,t}}{\lambda_{j,t}} =& \beta_0 + \beta_1(\log(\lambda_{j,t})) + \beta_2 \mathbb{1}^{\text{Clearable}}_{j,t} + \beta_{3-84}\mathbb{1}^{\mathrm{M/Y}} \\ &+ \beta_{85-381}\mathbb{1}^{\mathrm{R}}_{j} + \epsilon.\end{aligned} \tag{2}$$

  - $\lambda_{j,t}$: volume
  - $\mathbb{1}^{\text{Clearable}}$: clearable indicator
  - $\mathbb{1}^{\mathrm{M/Y}}$, $\mathbb{1}^{\mathrm{R}}_{j}$: month/year, reference entity

Hypothesis HA1: interdealer volume

	Dependent Variable
	Inderdealer Volume Share
Intercept	248.7***
CDS Clearing Eligible	-5.4***
log(Client Volume)	**-23.7*** **
Time Fixed Effects	Y
Reference Entity Fixed Effects	Y
Observations	38,817
Adjusted R^2	42.4%

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

Hypothesis HA2: number of dealers

- The number of dealers ($|\mathcal{D}|$) accommodating trade in a market potentially depends on the demand for trade, the risk-capacity of individual dealers, as well as the risk capacity of the entire market.
- Hypothesis H3 suggests that the completeness of a market's intermediation network is negatively related to the number of dealers.

$$\begin{aligned} |\mathcal{D}_{j,t}| =& \beta_0 + \beta_1 \mathbb{1}_{j,t}^{\text{Clearable}} + \beta_2 \text{K}_{j,t}^{\text{D}} + \beta_3 \text{K}_{j,t}^{\text{C}} + \beta_4 \log(\lambda_{j,t}^{\text{C}}) \\ &+ \beta_5 \lambda_{j,t}^{\text{D}} / \lambda_{j,t} + \beta_{6-87} \mathbb{1}^{\text{M/Y}} + \beta_{88-384} \mathbb{1}_j^{\text{R}} + \epsilon. \end{aligned} \tag{3}$$

- $\lambda_{j,t}$: volume
- $\lambda^{\text{D}}/\lambda$: fraction of interdealer volume
- $\mathbb{1}^{\text{Clearable}}$: clearable indicator
- $\mathbb{1}^{\text{M/Y}}$, $\mathbb{1}^{\text{R}}$: month/year, reference entity

Hypothesis HA2: number of dealers

	Dependent Variable				
	Number of Dealers				
	(1)	(2)	(3)	(4)	(5)
Intercept	21.4***	21.3***	27.5***	24.0***	27.7***
Interdealer Volume Share		**0.001****			**0.001*****
Interdealer Market Completeness			**-0.098*****		**-0.093*****
Client Market Completeness				**-0.253*****	**-0.078*****
CDS Clearing Eligible	0.186***	0.190***	0.112***	0.160***	0.115***
log(Client Volume)	-0.010	0.004	0.001	0.000	0.036
Time Fixed Effects	Y	Y	Y	Y	Y
Reference Entity Fixed Effects	Y	Y	Y	Y	Y
Observations	38,817	38,817	38,817	38,817	38,817
Adjusted R^2	86.9%	86.9%	93.2%	88.4%	93.3%

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

Hypothesis H4 & H5: execution cost

$$\begin{aligned}\mu^{\mathrm{C}}_{i,j,t} =& \beta_0 + \beta_1|\mathcal{D}_{j,t}| + \beta_2 \mathbb{1}^{\text{Clearable}}_{j,t} + \beta_3 \mathrm{K}^{\mathrm{D}}_{j,t} + \beta_4 \mathrm{K}^{\mathrm{C}}_{j,t} + \beta_5 \mathrm{k}^{\mathrm{D}}_{i,j,t} + \beta_6 \mathrm{k}^{\mathrm{C}}_{i,j,t} + \beta_7 \lambda^{\mathrm{D}}_{j,t}/\lambda_{j,t} \\ &+ \beta_8 \log(x_{i,j,t}) + \beta_9 \log(\mathrm{X}_{j,t}) + \beta_{10} \log(\sum \|x_{i,j,t}\|) + \beta_{11-92} \mathbb{1}^{\mathrm{M/Y}} + \beta_{93-389} \mathbb{1}^{\mathrm{R}}_{j} + \epsilon\end{aligned} \tag{4}$$

$$\begin{aligned}\mu^{\mathrm{D}}_{i,j,t} =& \beta_0 + \beta_1|\mathcal{D}_{j,t}| + \beta_2 \mathbb{1}^{\text{Clearable}}_{j,t} + \beta_3 \mathrm{K}^{\mathrm{D}}_{j,t} + \beta_4 \mathrm{K}^{\mathrm{C}}_{j,t} + \beta_5 \mathrm{k}^{\mathrm{D}}_{i,j,t} + \beta_6 \mathrm{k}^{\mathrm{C}}_{i,j,t} + \beta_7 \lambda^{\mathrm{D}}_{j,t}/\lambda_{j,t} \\ &+ \beta_8 \log(x_{i,j,t}) + \beta_9 \log(\mathrm{X}_{j,t}) + \beta_{10} \log(\sum \|x_{i,j,t}\|) + \beta_{11-92} \mathbb{1}^{\mathrm{M/Y}} + \beta_{93-389} \mathbb{1}^{\mathrm{R}}_{j} + \epsilon\end{aligned} \tag{5}$$

- $|\mathcal{D}|$: number of dealers
- x: individual dealer inventory
- X: net aggregate dealer inventory
- $\sum \|x_{i,j}\|$: gross aggregate dealer inventory
- $\lambda^{\mathrm{D}}/\lambda$: fraction of interdealer volume
- $\mathbb{1}^{\text{Clearable}}$: clearable indicator
- $\mathbb{1}^{\mathrm{M/Y}}$, $\mathbb{1}^{\mathrm{R}}$: month/year, reference entity

Hypothesis H4 & H5: dealer-to-client execution cost

	Dependent Variable				
	Dealer-Client Execution Cost ($\mu^{C}_{i,j,t}$)				
	(1)	(2)	(3)	(4)	(5)
Intercept	17.93*	17.9149	18.1596*	18.6753*	18.5967*
Interdealer Volume Share		0.0004			0.0004
Interdealer Dealer Completeness			-0.0110		-0.0103
Client Dealer Completeness			0.0137		0.0142
Interdealer Market Completeness				-0.0104	-0.0033
Client Market Completeness				-0.0065	-0.0312
log(Dealer ‖Inventory‖)	0.4213***	0.4214***	0.4091***	0.4198***	0.4067**
log(‖Net All Dealer Inventory‖)	-0.1907	-0.1914	-0.1833	-0.1900	-0.1812
log(All Dealer ‖Inventory‖)	-1.8847*	-1.8855*	-1.7885*	-1.7514	-1.7156
CDS Clearing Eligible	0.3577	0.3617	0.3174	0.3477	0.3146
Number of Market Dealers	-0.0684	-0.0684	-0.0934	-0.1240	-0.1233
Time Fixed Effects	Y	Y	Y	Y	Y
Reference Entity Fixed Effects	Y	Y	Y	Y	Y
Observations	295,327	295,327	295,327	295,327	295,327
Adjusted R^2	1.91%	1.91%	1.91%	1.91%	1.91%

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.

Hypothesis H4 & H5: interdealer execution cost

	Dependent Variable				
	Interdealer Execution Cost ($\mu^{D}_{i,j,t}$)				
	(1)	(2)	(3)	(4)	(5)
Intercept	0.2314	0.2201	0.6452	0.2513	0.5861
Interdealer Volume Share		0.0001			-0.0001
Interdealer Dealer Completeness			0.0090		0.0106
Client Dealer Completeness			**-0.0411*****		**-0.0425*****
Interdealer Market Completeness				-0.0011	-0.0093
Client Market Completeness				0.0076	**0.0787*****
log(Dealer ‖Inventory‖)	-0.0095	-0.0094	0.0619	-0.0096	0.0608
log(‖Net All Dealer Inventory‖)	0.0062	0.0062	0.0037	0.0055	-0.0037
log(All Dealer ‖Inventory‖)	-0.0945	-0.0945	-0.2168*	-0.0920	-0.2282**
CDS Clearing Eligible	0.0644***	0.0652***	0.1511***	0.0633***	0.1469***
Number of Market Dealers	0.0089	0.0088	0.0285	0.0067	0.0225
Time Fixed Effects	Y	Y	Y	Y	Y
Reference Entity Fixed Effects	Y	Y	Y	Y	Y
Observations	1,053,312	1,053,312	1,053,312	1,053,312	1,053,312
Adjusted R^2	0.02%	0.02%	0.10%	0.02%	0.10%

Source: Authors' calculations, which use data provided to the OFR by the Depository Trust & Clearing Corporation.